Key to Whooping Crane Survival—Page 3

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Regulating Plant Growth

A 12-foot-tall cabbage may not be practical, but it demonstrates the power of growth-regulating chemicals.

These chemicals stimulate plant growth and govern plant behavior to meet the needs of modern agriculture. They thin tree fruits, stimulate cuttings to make roots, improve fruit set and size, and accelerate or retard growth of ornamentals. Someday, growth regulators may even improve the palatability and nutritive value of certain food plants.

Some 42 growth-regulating chemicals are now approved by ARS' Pesticide Regulation Division for more than 100 different uses in crop production, and the number and importance of these chemicals is steadily increasing.

Among the most important commercial users of growth-accelerating chemicals are the producers of Thompson seedless grapes in California. They use the sprays to stimulate growth and cause plants to produce loose clusters of large, elongated fruits. About 25,000 to 35,000 acres are sprayed each year for this purpose and in the near future, practically all Thompson and seedless grapes grown for table use will be treated.

Among the other users of growth regulators are potato farmers who give potatoes a longer storage life and florists who produce desirable stunted plants for indoor display. The largest use of growth regulating chemicals, however, is in killing weeds. The compound 2,4-D, for example, was first discovered to be a growth regulating compound, but it is now a widely used herbicide.

Among the ARS research projects dealing with growth regulators is the study on using chemicals to eliminate the tedious, time-consuming chore of pruning ornamentals (p. 6).

Before growth-regulating chemicals can be commercially approved, it must be proved that they are harmless to man and do not adversely affect his environment—a costly process. Some scientists are now studying certain edible plants—corn, for example—as a possible source of growth regulators. Regulators obtained from food plants are likely to be relatively nontoxic.

Through further research, additional ways will be found to use growth-regulating compounds safely and effectively in the production of more desirable crops.

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Cytogeneticist P. A. Sarvella (left) removes a feather from the sandhill crane with tweezers. Zoologist C. E. Knoder holds the bird.

ST–1913–4

AVIAN CHROMOSOME PHOTOGRAPHS

One step toward saving the whooping crane and toward improving domestic birds

PLUCK A FEATHER, treat it, dissect it, photograph its chromosomes under a microscope—these steps may help save the whooping crane and other species of wild birds from extinction.

As early as colonial times, men have attempted to protect U.S. wildlife, usually by restricting hunting. Today, scientific wildlife management protects many species from extinction, but not all. Some species require more help than conventional management can give. These species are officially called "endangered"; their survival may depend on new approaches and techniques.

Through avian genetics, research scientists may be able to select ideal mates from small populations of birds and breed to overcome the genes that may have made a particular species unable to protect itself in a continually evolving world.

The research may also lead to a better understanding of avian evolution. Major improvements in domestic birds—chickens, turkeys, ducks—may well depend on techniques that allow breeders to match chromosomes in one species with compatible chromosomes in another.

ARS cytogeneticist P. A. Sarvella is conducting the study at Beltsville, Md., with zoologist C. E. Knoder of the Department of Interior's Bureau of Sports Fisheries and Wildlife. He is head of propagation research at the nearby Patuxent Wildlife Research Center, Laurel, Md.

The scientists began their investigation by developing research techniques for studying sandhill cranes. The sandhill crane, while not in danger of extinction, is related to the whooping crane, one of 34 species of birds that face extinction unless man can help it survive.

By treating pulp from the feathers of a sandhill crane with the chemical colchicine and fixatives, cytogeneticist Sarvella, in effect, froze the pulp tissue cells in various stages of growth and division. Then, with a camera-equipped microscope, she photographed the treated tissue until she had pictures of cells in which the chromosomes were clearly defined and separated.

Using enlarged photographs of the separated chromosomes, she arranged the chromosomes into a picture, called a karyotype. She made the karyotype of the sandhill crane by cutting the chromosomes from the photograph of the cell and arranging them by length and, in the case of more complex chromosomes, by the position of a belt-like stricture, called a centromere, on

the chromosomes.

When she has completed photographing the chromosomes of the whooping crane, the scientists will have two species in the same family whose karyotypes can then be compared visually for chromosome number and size, and for position of centromeres. "Chromosome karyotypes that look alike," she says, "probably have common ancestry."

"Cranes are an old species in an evolutionary sense," Knoder explains. "Probably most species faced with extinction are old."

By comparing the karyotype of an old species, such as the sandhill crane, with the karyotype of a newer species, such as the chicken, poultry scientists may be able to determine how closely related they are, cytogeneticist Sarvella points out.

The research has short-term goals as well as the long-term goal of understanding avian evolution, Knoder adds. "It's difficult, for example," he says, "to determine the sex of cranes—especially whooping cranes—before they reach maturity. We hope that once we have mapped the chromosomes of these birds, we will find a key to determining the sex of chicks that are just a few months old."

Early determination of sex in whooping cranes could be a boon to wildlife specialists. With relatively few of these cranes in captivity, wildlife specialists must be able to sex young cranes as soon as possible so that pairs can be established and, when necessary, isolated. All told, there are only about 50 whooping cranes in the wild and captivity.

With small populations, it is also important to select the best birds for breeding stock. Scientists now must wait for congenital abnormalities to show up in the birds—perhaps after lengthy trial and error mating—before knowing if the birds will make satisfactory breeders. This may require years of waiting; the sandhill crane, for example, does not reach sexual maturity until about 4 years of age.

But by examining the chromosomes of young birds, the scientists hope to develop techniques for recognizing potentially good breeders and rejecting less favorable ones. At the same time, they may help the species overcome some of the handicaps brought about by inbreeding in such small populations.

Karyotypes will also provide excellent records of the species in the event that man cannot protect them, and they do become extinct. Previous species that have become extinct left no record and must always remain a question mark in our knowledge of evolution. The passenger pigeon, for example, vanished during the 1920's; scientists have no record of its genetic makeup and no precise knowledge of its place in avian evolution.

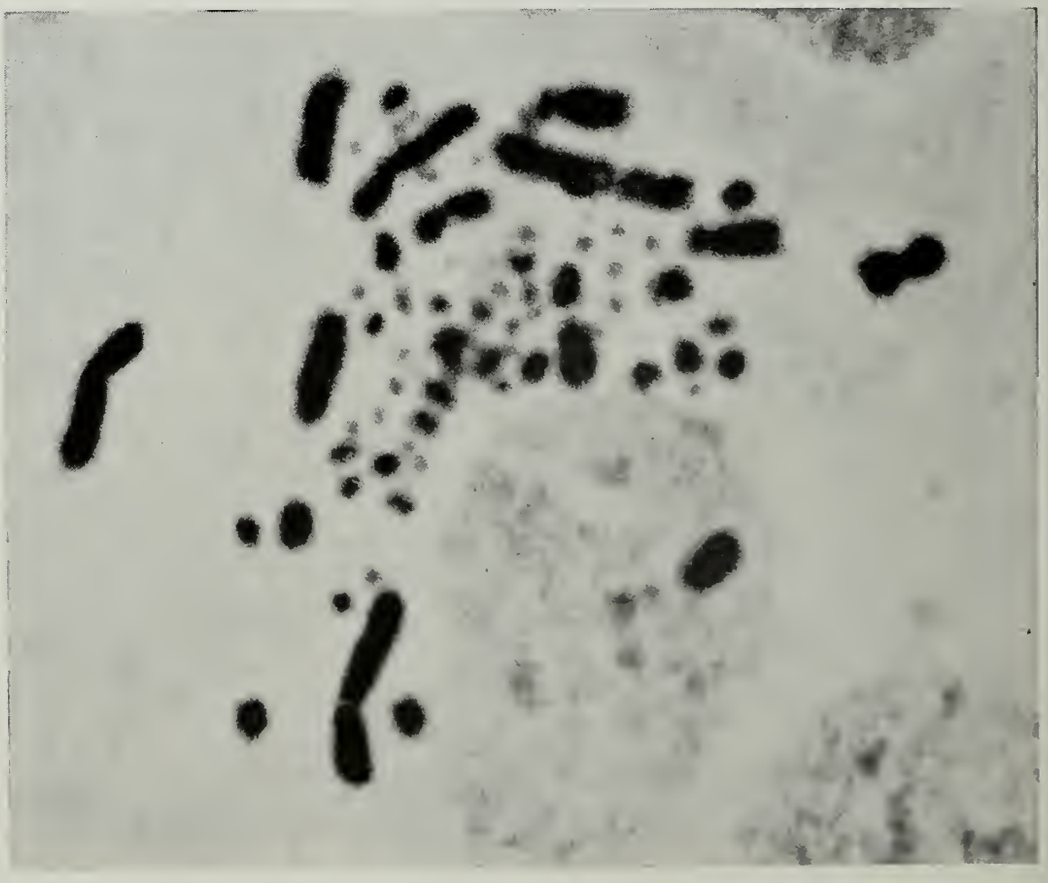
But it is in the future of agriculture that this research has its most far-reaching possibilities. Because of similar basic work in genetics, plant breeders have been able to transfer desirable characteristics from one species to another. Animal breeders have yet to achieve this level of sophistication, partly because less is known of the genetic makeup of important animal species, including poultry, than is known of plant species.

But at some time in the future, research such as this may enable poultry breeders to transfer desirable characteristics—disease resistance, perhaps—from wild birds to domestic poultry.

This research may also someday enable poultry breeders to create hybrid birds with tailor-made qualities that are superior to those of our present commercial species.■

Chromosomes in the feather pulp of the sandhill crane. Centromeres are the belt-like strictures on the chromosomes.

PN-1538



BREAST BLISTERS

Scientists Study Poultry Marketing Problem

BREAST BLISTERS, a growing problem besetting producers of chickens and turkeys, develop from infections in small breast cavities, anatomy studies show.

The cavities, apparently natural horizontal splits in the breast skin, are not shared by related species. They appear to provide a cushion against mechanical stress.

Current poultry production practices bring along with them special skin irritants, such as metal feeders, wire cages, crowded floors, and wet litter. These irritants cause infected cavities, or blisters, along the centerline of the breast, which in extreme cases cause part or all of the bird to be discarded. Broiler producers estimate that 5 to 10 percent of the downgrading of their chickens is due to breast blisters.

Examination of ducks, quail, and pigeons failed to reveal breast cavities. These birds seem to be protected from stress on the breast by fat-layered connective tissue, and researchers think it conceivable that this type of structure might be bred into chickens and turkeys to help them resist irritants without developing infected blisters.

Studies on the structure of normal and abnormal breast tissues by ARS avian zoologist A. M. Lucas are part of a comprehensive analysis of avian anatomy at East Lansing, Mich., in cooperation with the Michigan Agricultural Experiment Station. Besides Leghorn chickens and Bronze turkeys, the study includes Pekin ducks, common pigeons, and Japanese quail.

In studies of breast cavities in chickens at varying stages of development, Lucas found that the skin and underlying areas of the breast in a 2-week-old bird are no different from similar tissues in other parts of the bird. In a chicken of 4½ weeks, however, Lucas saw the beginning of a slit-shaped cavity in the anchors of the breast muscles just above the cartilage of the breast bone.

Lucas says that when layers of tissues in young birds are separated, small splits result. He identified mechanical splits by lack of a lining around the cavity. A true cavity is bordered with a single row of flattened cells.

Upon dissecting a 6½-week-old chicken, Lucas found a second cavity separated from the first by a thin, fragile sheet of loose connective tissue. In the older birds studied, tissues around the breast cavity were more defined and strands had grown from wall to wall.

An adult male examined by Lucas had a single cavity probably formed by the rupture of thin tissues separating two smaller cavities, but no blister or swelling was visible above the skin. Lucas found a small vascular structure projecting into the cavity that might be capable of introducing the fluid characteristically found in infected blisters.

No white blood cells or other disease-fighting cells appeared near the cavity, leading Lucas to confirm that the tissue remodeling he found is the result of irritations from outside the bird rather than an infection inside it.

Because skin structure of the breast of such a chicken is clearly altered by mechanical irritation and not by an infectious agent, Lucas believes that the breast meat of the bird can be eaten safely.

In fact, the consumer would not be aware of the structural changes in a bird that had a breast cavity but not a true breast blister.■

Scientists Advance Chemical Pruning

ARS SCIENTISTS ONLY recently learned how to prune chemically side buds from chrysanthemums without harming the growing tip.

Now, they have developed emulsions from fatty acid derivatives that do exactly the opposite.

The emulsions kill the growing tip in chrysanthemums and other ornamentals without harming leaves, stems, or side buds. They are derived from raw materials such as cottonseed and soybean oils and animal and coconut fats.

Removing buds from ornamental plants by hand is tedious and time consuming. Horticulturist H. M. Cathey and other ARS scientists found that a naphthalene-base oil emulsion kills side buds on chrysanthemums without harming the growing tip (AGR. RES., Aug., 1966, p 6). The result of this kind of pruning is a single, large flower at the top.

With the fatty acid emulsion, however, they can selectively prune side buds from chrysanthemums or prune the growing tip from a variety of ornamentals without having to do either by hand.

Plants sprayed with the emulsion develop side shoots almost as soon as plants pruned by hand. Also, more shoots sometimes develop and at a wider angle to the stem. With some ornamentals this produces a larger,

Here, horticulturist H. M. Cathey uses an electric aerosol machine to apply the fatty acid derivative emulsion to chrysanthemum plants in the greenhouse.

ST–2159–15

The chrysanthemum plant at left has been pruned with the fatty acid emulsion; the other has not.

ST–2159–7

more attractive flower cluster.

The fatty acid emulsions may eventually be adapted to do a number of pruning jobs more easily and less expensively. For example, they might be used to control desirable shrubs that create obstructions along roadways and around power lines. Now, the only practical way to do either is by clipping.

Unlike the naphthalene-base oil emulsion, the emulsions of fatty acid derivatives work on a variety of ornamentals. Cathey and plant physiologists G. L. Steffens and N. W. Stuart have used them successfully on elms and chrysanthemums, hydrangeas, marigolds, and other ornamentals. The fatty acid derivative emulsions kill the growing tip on ornamentals in less than an hour.

Both emulsions are still experimental, however, and not recommended for general use.

An important component of the fatty acid emulsion is the surfactant, a chemical that acts as a carrier of other chemicals, increasing and regulating the efficiency of the latter. The surfactant in the fatty acid emulsion plays a larger role, however. Without it, the fatty acid derivatives are toxic to plants.

The emulsion is applied with an electric aerosol machine that releases the emulsion in very fine particles. This prevents large amounts from settling on plants and reduces the danger of overdosing.

The fatty acid emulsions work easily on plants that are vegetative, have hairy leaves, and have space between the leaves. More difficult to prune chemically are plants that have waxy leaves and grow in a stop-and-go manner, such as pines.

It is impossible, the researchers say, to use the fatty acid emulsion for pruning seedlings, dormant plants, and plants with enclosed growing points.■

GRAINS *for* *Southern Grasslands*

THE 6 MILLION acres planted to Coastal bermudagrass in the Southeast could be producing grain as well as forage, ARS experiments indicate.

Coastal was developed some years ago by ARS plant breeders, and has been instrumental in boosting beef production in the Southeast. Soil scientists L. F. Welch and S. R. Wilkinson recently concluded a 3-year experiment during which they seeded rye directly into Coastal sod.

The rye yielded as well as conventionally seeded rye—26 bushels per acre on the average—and the Coastal yielded about the same on the average as it did when it was grown by itself: 6.15 tons per acre compared to 6.18 tons per acre on Coastal-only plots.

The rye was seeded in October and harvested in June. Coastal was cut in June, July, August, and September. The first cutting of Coastal was invariably poorer than normal because the mature rye shielded the grass from sunlight. Once the rye was harvested, however, the grass recovered rapidly.

Besides providing farmers with two crops from the same land, the rye-Coastal combination offers another distinct advantage: It helps control erosion. Much land in the Southeast is rolling or hilly. Grain fields that are plowed and planted in the conventional manner are subject to erosion. By planting directly in Coastal sod, the farmer insures a year-round cover for his land.

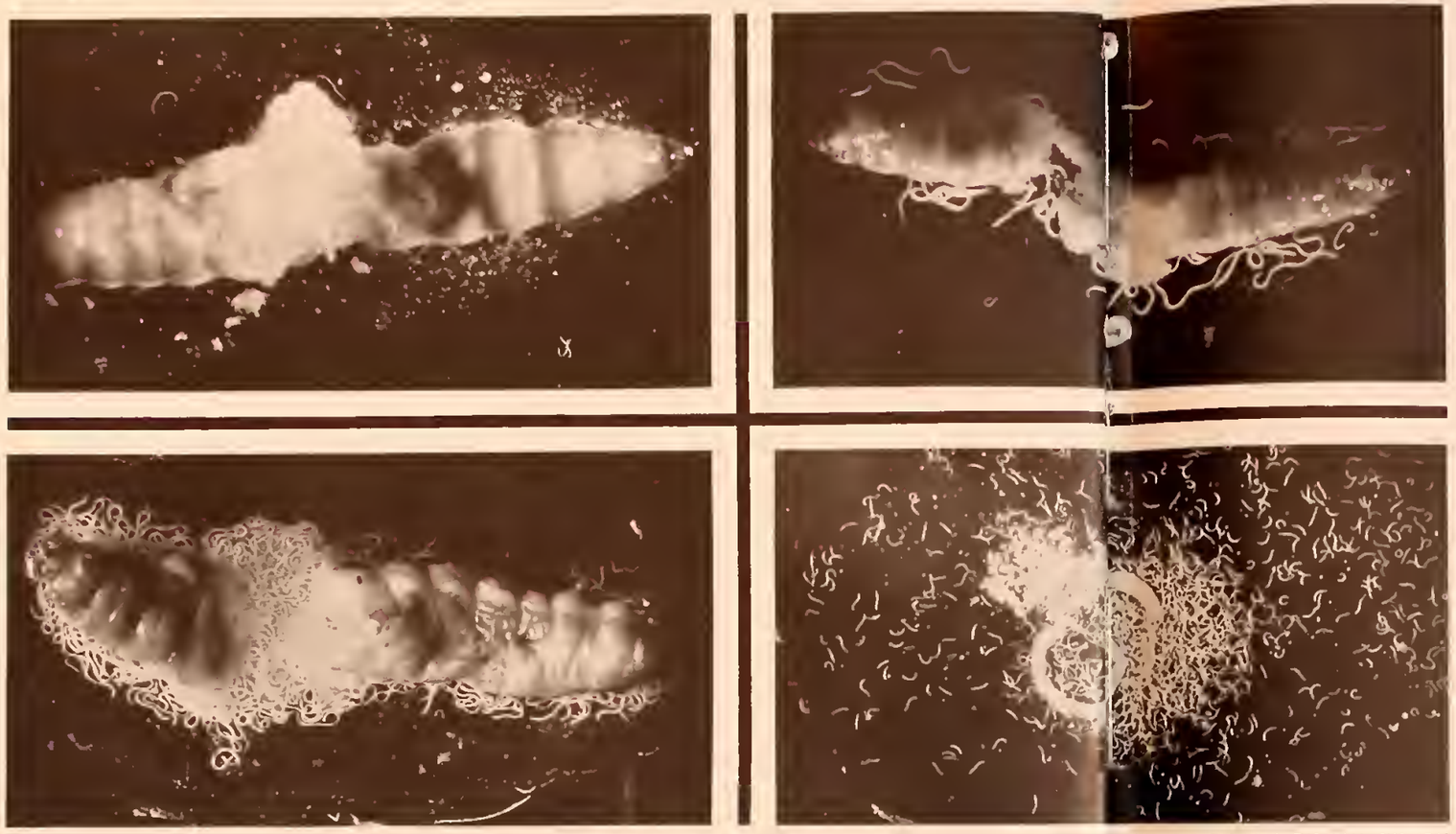
Also, the rye-Coastal combination makes fuller use of available moisture. About 50 percent of the annual rainfall in the region falls when Coastal is dormant.

Welch and Wilkinson applied varying amounts of fertilizer to their test plots. When rye was heavily fertilized, Coastal yields tended to decline, probably because the denser rye growth cast more shade. Best all-around results were achieved with application of 120 pounds of nitrogen per acre for rye and 200 pounds for Coastal.

A grassland drill with discs for cutting into the sod was used to plant the rye. This disturbance of the sod seemed to have little effect on forage yield.

The work was conducted at the Southern Piedmont Conservation Research Center, Watkinsville, Ga., in cooperation with the Georgia Agricultural Experiment Station.■

NEMATODE-BACTERIA TEAM for INSECT CONTROL



PN-1539, PN-1540, PN-1541, PN-1542

Progressive stages in the attack of the DD 136 nematode against larva of the wax moth. The moth is a destructive pest of honey bees. Photos show the second, third, fourth and sixth day of attack.

SCIENTISTS ARE working to exploit a fortunate partnership between a nematode and bacteria that may control several major insect pests.

The microscopic worm, named the DD 136 nematode, carries bacteria that kill insects, but is itself apparently immune. The bacteria have no scientific name as yet.

Certain kinds of nematodes are harmful to crops and animals, but the DD 136 nematode and its bacterial hitchhiker affect only insects. From the insects, the nematode obtains sterols—chemicals occurring naturally in the insect's bodies that are essential to the nematode's growth and reproduction. Discovery of the nematode's use of the insect sterols was made by ARS biologist S. R. Dutky and his associates at the Insect Physiology Pioneering Research Laboratory, Beltsville, Md. (See accompanying story.)

Large numbers of the nematode can be reared easily and cheaply in the laboratory. The nematode can then be stored in cans for long periods without food or insect hosts and used when needed.

Applied with conventional spray equipment, the nematode can be mixed in a water solution and simply sprayed on plants or other places infested by insects. When protected by shade, the nematode will survive extended periods of drought, Dutky discovered.

Unlike conventional insecticides, the nematode poses no problems in dose preparation, drift, or residues. Also, the nematode is resistant to most commonly used insecticides, fungicides, and herbicides. This makes the nematode a promising candidate for use in an integrated control program that combines various pesticides and management practices.

Although bees are susceptible to the nematode, they're not greatly threatened by nematodes that are sprayed on orchards. Nematodes picked up by bees in an orchard would probably dehydrate before the bees returned to their hive. Even if some nematodes survived the flight, there would be little threat of wiping out future generations of bees because temperatures of the young brood are unfavorably high for the nematodes.

Dutky's tests show the nematode can control insects beyond the reach of conventional sprays. Nematodes sprayed on peach trees killed borers deep within the trunks. They also killed boll weevil larvae concealed in the buds of cotton plants.

In tests with the codling moth—a pest of apples and pears—Dutky found that the nematode killed 60 percent of the larvae within 2 weeks after treatment of the trunk and main branches of trees. Larvae crawled over sprayed areas when seeking sites for spinning cocoons and died soon after picking up the nematodes.

The nematodes spread to succeeding broods of moths and killed larvae as late as 3 months after the trees were sprayed. The tiny worms have survived and spread for 11 years without the aid of man in one orchard near Stevens City, Va.

Houseflies are another pest attacked by nematodes. Within 2 days after they were sprayed in poultry houses near Miami, Fla., the nematodes killed 40 percent of the houseflies breeding in the manure.

Dutky is continuing to obtain information on the nematodes' effects under various environmental conditions and other factors that affect potential use of this control.■

Utilizing Insect Metabolism

CHEMICALS IN THE bodies of insects that are vital to their life processes provide the basis for another biological approach to pest control.

Insects (as well as nematodes) might be controlled by interfering with their metabolism of sterols—alcohols that help them digest food and complete their life cycle.

In one study involving insects, for example, ARS entomologist J. A. Svoboda at Beltsville, Md., found two chemicals that block the tobacco hornworm's enzymes from converting sterols to the cholesterol essential to its growth, thus interfering with the insect's development.

And using biological means to achieve the same end, ARS biologist S. R. Dutky, also at Beltsville, discovered that when the tiny DD 136 nematode attacks insects it converts insect sterols to delta–7 cholesterol, a material essential to the nematode's growth and reproduction. Scientists are now developing an artificial diet on which to rear these nematodes cheaply and in large quantities. Other scientists are using the knowledge as a springboard to test possible ways for utilizing the nematode in insect control.

Ultimately, the findings on insect and nematode sterols may have an important bearing on man's health. One of the chemical similarities between man and the lower animals is the presence of sterols in their tissues. Unlike insects, which obtain sterols from plants, man produces his own essential sterols.

Unfortunately, some people produce too much, or eat food containing undesirable amounts of certain sterols, such as cholesterol, which may lead to heart and circulatory illnesses. More knowledge about sterols may result in ways to reverse or prevent this condition.■

PN-1545

for DAIRY COWS . . .

Mechanized Feeding System

EIGHTY DAIRY COWS can be fed by an automated system that requires only 30 minutes a day of a dairyman's time to set the system in motion.

The experimental system moves various feed ingredients at predetermined quantities and rates from storage and mixes the ingredients into a ration. It then distributes the ration to each of four groups of cows. Ingredients handled in the experimental system are grass silage, haylage, corn silage, and concentrate ration.

The system is operated by a 24-hour time clock, delivering feed as frequently as every 2 hours or as infrequently as once a day.

Located on a University of Illinois dairy farm, the mechanized feeding system is a complex of three silos, four cow lots, a feed processing and storage center, two stall sheds, a housing shed, two feed bunks, a milk room, and a milking parlor.

Agricultural engineer H. B. Puckett of ARS and engineer E. F. Olver and dairy scientist K. E. Harshbarger of the University of Illinois designed the feeding system to accommodate 20 dry cows and 60 milking cows divided into three production groups of 20 each. Feed is proportioned on the basis of milk production and distributed to the four groups of cows automatically.

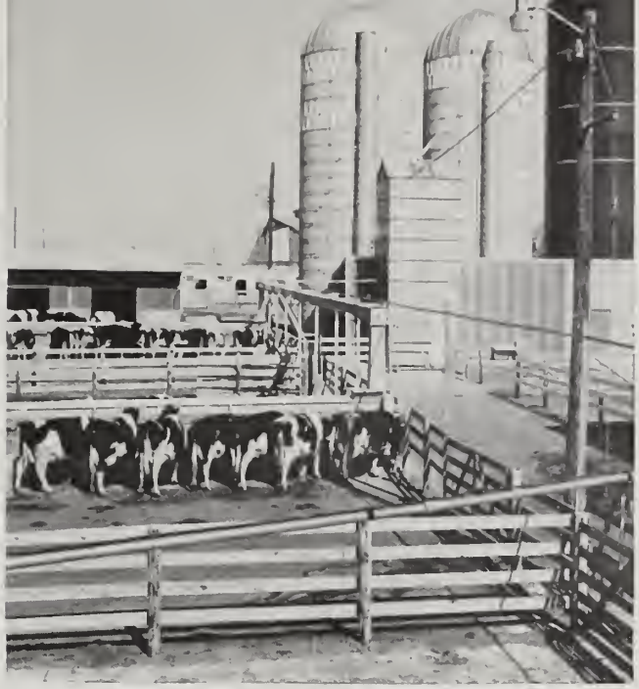
The silo that stores corn silage and the silo that stores grass silage are both unloaded from the top by unloader units that are supported by cables. Each top unloader consists of an auger that gathers the silage to the center of the silo and a blower that discharges the silage from the silo at a constant rate. The third silo is airtight and stores haylage; it unloads from the bottom.

Concentrates—ground and blended in a hammermill that is an auxiliary system—are stored in a tank. Each of the storage units delivers feed ingredients to an auger; the auger conveys the feeds, mixing them in transit, to an elevator which lifts the feed 10 feet above ground.

From this elevator, feed is diverted into another auger, 90-feet long, that runs to the vicinity of the feed bunks. If feed is to be delivered to the first feed bunk, the auger turns backwards, operates only the first 10-foot section, and delivers the feed to a smaller conveyor, which dumps it in the feed bunk. If feed is required at the second bunk, the auger motor reverses, and the entire 90-foot section turns.

The system design incorporates safety features to (1) indicate when the concentrate tank is empty, (2) prevent overloading of the auger motors, (3) show when the silage is not being delivered, and (4) prevent the top silo unloaders from gathering too much or too little silage. If failure in any of the equipment develops, the controls automatically shut off the system.■

Three sensing fingers at right operate parallel switches to sense silage flow in the auger. If no silage flows for a preset time, the system is shut off.



PN–1546

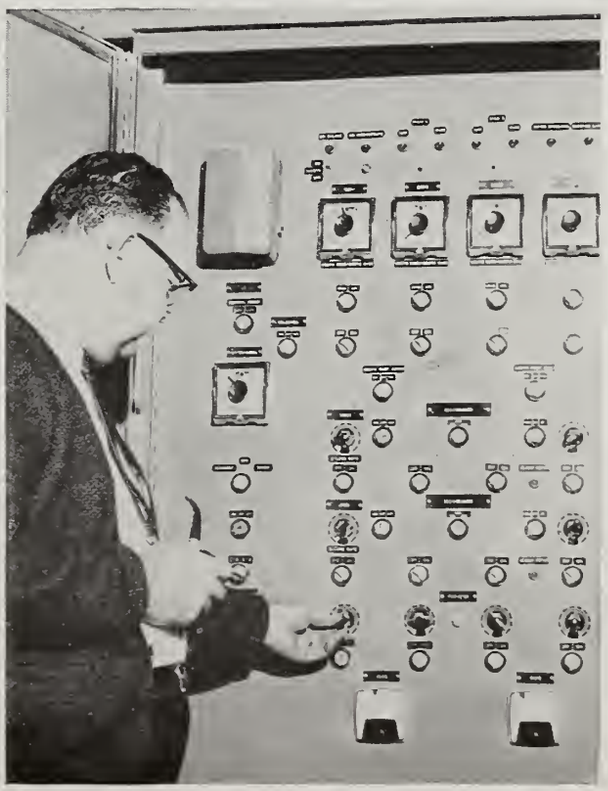
Above: The four cow lots. In the background, the airtight silo on the right has a bottom unloader; the other two use top unloaders.

The horizontal collection and mixing auger for the three silos is at the lower right.

PN–1547

The hammermill where grain is ground and mixed, then dropped to a pneumatic conveyor for delivery to various locations. Puckett is clamping a delivery tube to one of the pipes.

PN–1548



The control panel. Puckett is setting the delivery rate of the feed meter. The time clock at upper left can be set to start the feeding sequence any number of times per day.

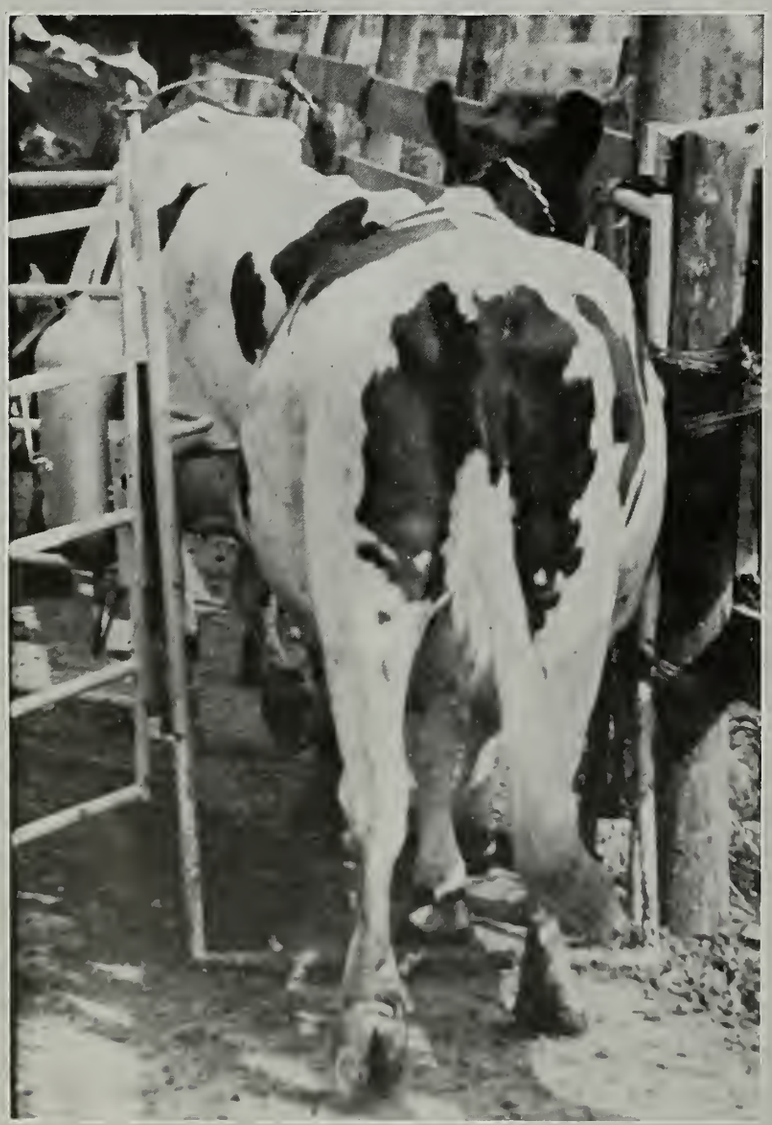
PN–1549

Ultralow-Volume Spraying for
HORN FLY CONTROL

CATTLE PRODUCERS may soon press a new weapon into battle against the horn fly, a pest of cattle that causes heavy economic losses.

The weapon, an experimental sprayer, automatically applies insecticide to cattle at ultralow rates to protect them from the pest. Developed by ARS agricultural engineer Allen Miller and entomologist J. E. Eschle, working at Kerrville, Tex., the new sprayer can dispense 1 to 5 milliliters—about one-thirtieth to one-sixth ounce—of spray accurately, consistently, and precisely.

The horn fly is a small bloodsucking pest that is extremely annoying to cattle and a constant drain on their vitality. The fly is found year around in Texas and Florida, and appears in other parts of the country in the spring and summer. Large numbers of horn flies can reduce milk production in dairy cattle by 10 to 20 percent and prevent weight gains in beef cattle by as much as one-half pound a day.



Cows pass through the ultralow-volume spraying system. PN-1543

Many cattle producers now fight the fly with automatic sprayers and other devices that permit the cattle to treat themselves (AGR. RES., Sept. 1963, p. 16). Although these devices have shown potential for reducing pesticide residues in meat and milk, use of some of the more effective and less costly insecticides is limited because of the residue problem.

The experimental sprayer is designed to provide effective control with a minimum of insecticide. And because the sprayer uses less insecticide, the costs of treatment are lowered.

The heart of the ultralow-volume sprayer is a measuring control device that regulates the amount of spray forced through the nozzle and onto the cow. A single nozzle is located so that it applies a band of spray approximately 1 foot wide from the withers to the loin on one side of the animal. Because horn flies are very active, treating one side of the animal is sufficient.

Cattle passing through the passageway of the sprayer activate the system by pushing a lever. It takes less than 1 second to spray the cow, and the spray is automatically cut off when the proper dosage has been applied. The amount of spray can easily be adjusted.

Compressed air is used to operate the system, eliminating the need for electrical outlets and making the system completely portable.

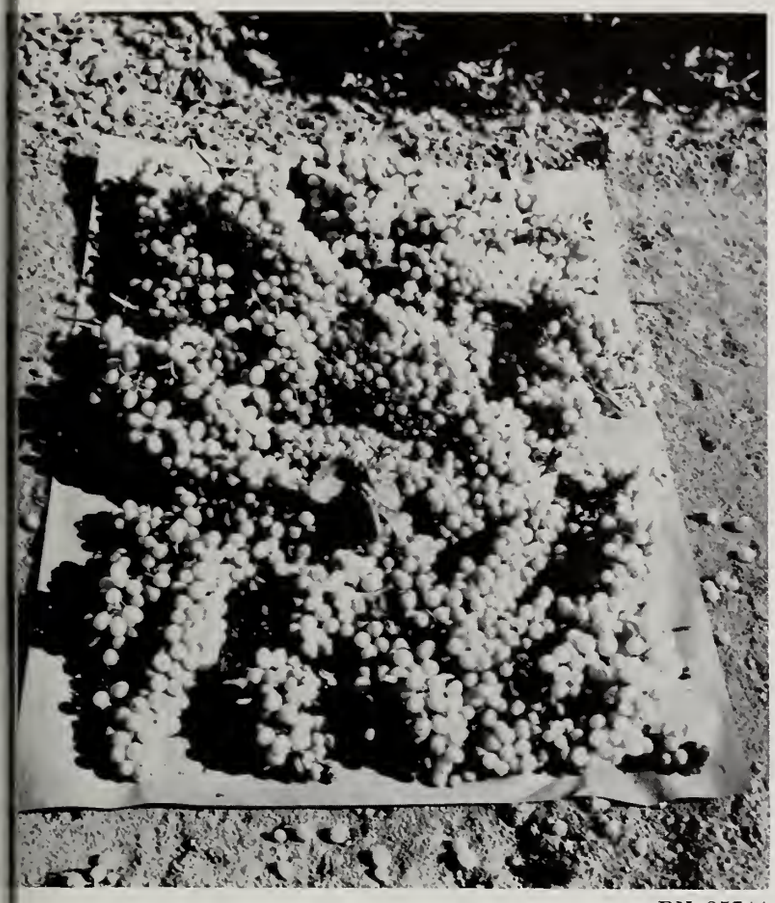
The sprayer can consistently deliver the preset volume of material to either fast-moving or balky animals and operates quietly to avoid startling them. A recovery and reset time is maintained that is fast enough to treat cattle following each other closely.

In 5 months of field studies, ultralow-volume sprayers were used on the farms of two cooperating dairymen. Cattle were treated with *alpha*-methylbenzyl 3-hydroxycrotonate dimethyl phosphate in xylene at a rate of 1 milliliter twice daily per animal. A 2-percent solution was used on a herd of 150 cows, and a 1-percent solution was used on a herd of 300 cows.

Complete horn fly control was attained on the treated animals, but from 500 to 1,000 horn flies were counted per untreated animal.

The second year of field testing is underway, as well as tests to determine application rates and effectiveness of various insecticides. Miller and Eschle are also conducting tests to determine if insecticide residues appear in milk from animals treated with the ultralow-volume spray. ■

Treated Trays Protect Raisins



BN-25744

Fresh grapes lie in the field on the treated paper drying trays.

BN-25746

The paper trays were rolled to complete the raisin-drying process.

MALATHION-TREATED raisin drying trays that provide improved insect control at less cost are rapidly being accepted by California raisin producers and processors.

The treated trays, developed by ARS in cooperation with the California Raisin Advisory Board, Crown Zellerback Corporation, and the American Cyanamid Company, will be used for about 25 percent of this season's crop, according to entomologist H. D. Nelson, Stored-Product insects Laboratory, Fresno, Calif.

Last year was the first time large-scale commercial use was made of the treated trays. About 10 percent of the crop, or 28,000 tons of raisins, was dried on 10 million malathion-treated trays. This season about 25 million treated trays will be used for a proportionately larger part of the crop.

If the total crop was dried on trays, the savings in fumigation costs would be more than $500,000 per year, Nelson said. It costs about $3.27 per ton to control insects with fumigation but only $1.20 per ton with malathion-treated trays—a savings of more than $2 per ton.

The first tests were made in 1961. Results were promising, and tests were expanded each year thereafter. To determine appropriate level of application, Thompson seedless grapes were placed on trays containing malathion at three levels of concentration: 30, 150, and 300 milligrams per square foot. The middle range seemed most effective. Accordingly, 200 milligrams per square foot was used last year. This year, 100 milligrams per square foot are expected to provide adequate insect control, Nelson said.

In the tests, the malathion protected the grapes (raisins) from insects while drying, and the raisins picked up enough malathion from the trays to protect them during storage. The amount of malathion residues on the raisins, however, was below the tolerance level of eight parts per million set by the Food and Drug Administration. Although little residue was lost during storage, some was lost later in processing.

In laboratory tests, amounts below the tolerance level, Nelson added, virtually prevented development and reproduction of two pests of stored products—Indian-meal moths and saw-toothed grain beetles—for at least 1 year.■

Plant Chamber from a Bucket

FROM A PLASTIC bucket, two ARS scientists built a chamber that measures the photosynthesis of whole plants.

The new chamber costs about $5 to build but has proven as reliable for most jobs as chambers costing more than $1,500. The inventors of the chamber are plant physiologist B. R. Roberts and plant pathologist R. J. Stipes at the Shade and Wind Tree Laboratory, Delaware, Ohio.

The usual way scientists measure photosynthesis is to measure the absorption of carbon dioxide in leaf parts, but scientists often need to measure the photosynthesis of entire plants. That's when a simple and accurate apparatus that does the job comes in handy.

Besides a polyethylene utility pail and its lid, the scientists used a few feet of rubber hose, a small plastic container, a thermometer, and a 150-watt floodlight to build the apparatus.

In experiments, the plant to be tested is sealed in the pail and the floodlight provides light for photosynthesis. The plastic container is mounted at the top of the pail and fitted with rubber tubes to circulate water and serve as a water bath to control the temperature within the pail. The thermometer and two more rubber tubes that provide air flow are inserted through holes drilled in the side of the pail.

Scientists pass a stream of air of known volume through the pail by the air inlet tube and collect it from the air outlet tube. The carbon dioxide content of the air is then measured. The difference in the carbon dioxide concentration before and after entering the pail tells scientists the rate of photosynthesis.

The ARS researchers say that the chamber has proved extremely reliable and useful in numerous experiments measuring the gas exchange of intact shoots.■

Testing Meat Storage Atmospheres

WHAT HAPPENS to the quality of meat when it is kept in a storage atmosphere different from air?

Scientists in Helsinki, Finland, are looking for the answer under a Public Law 480 research grant awarded by ARS. Such grants are made from local currencies obtained through the sale of U.S. surplus food. This currency cannot be converted into dollars for use in the United States. The study is the first comprehensive evaluation of the effects of storage gases on meat palatability.

Under the direction of microbiologist M. S. Pohja, meat samples are stored in air and in atmospheres containing carbon dioxide levels of 10, 20, 30, and 40 percent. Tests are also made with nitrogen levels of 90 and 95 percent. All tests are made with a storage temperature of 32° F. and a relative humidity of 95 percent.

Scientists kept a meat sample in the most effective carbon dioxide concentration, 40 percent, three times longer than a sample from the same piece of meat kept in air. The bacterial count of the meat stored in carbon dioxide was much lower, both on the surface and within the tissues.

Tests with high nitrogen levels did not maintain meat quality. Bacterial counts on the meat surface were 1½ to 2½ times as great after 12 days in 90 or 95 percent nitrogen atmospheres as they were on samples held in air.

The most serious problem encountered so far has been changes in meat color. In 40 percent carbon dioxide, for example, the meat turns grayish-red on the surface after 19 days in storage. It becomes grayish-brown after 26 days. Color changes had no effect, however, on flavor after cooking.

For the study, the researchers remove two loin muscles from a beef carcass within 2 hours after slaughter and divide each muscle into eight parts. They place eight pieces in air storage and eight in the modified atmospheres.

Scientists use samples from the same piece of meat for comparison studies because the normal storage life of a particular piece of meat varies depending on its bacteria count.

Taste, flavor, and tenderness tests are made on each sample by a taste panel. Bacteriological samples and chemical analyses are also made at regular intervals until the meat develops off odors and the surface becomes slimy.

AGRISEARCH NOTES

Vitamin C: Harvesting Aid

Vitamin C may help solve a major problem of mechanical citrus harvesting—getting the fruit to fall easily.

In two tests at Orlando, Fla., ARS plant physiologist W. C. Cooper and technician W. H. Henry found that the application of ascorbic acid (vitamin C) effectively induced abscission (dropping) of Pineapple oranges. As a beneficial side effect, the method increased the vitamin C content of the oranges from 4 to 8 percent. There was no other significant change in the composition of the oranges.

Induced abscission is simply an aid to the natural process that causes fruit to drop from the tree. Other methods of induced abscission, however, had also caused leaf abscission, one problem scientists are trying to overcome. Ascorbic acid caused no leaf abscission in the Orlando tests.

Another problem that concerns scientists is "plugging." Fruit that does not easily separate from the stem will sometimes leave a small bit of rind attached to the tree. This "plug" makes the fruit less attractive. There was no plugged fruit from any of the plants treated with ascorbic acid.

The ascorbic acid treatment, however, frequently causes small reddish pits in the rind near the stem end of the fruit. Current tests with sodium ascorbate (sodium salt of ascorbic acid) indicate that the salt form is less toxic to the fruit than the acid form. If the residue is washed off the tree 3 days after applying ascorbic acid, pitting of the rind does not occur.

In the tests, sets of orange shoots with the fruit and leaves attached were treated with different concentrations of ascorbic acid. The 2-percent and 5-percent ascorbic acid solutions were very effective in inducing fruit abscission; the 2-percent solution caused about 75 percent of the fruit to drop off easily when the branch was shaken by hand. All fruit that dropped separated clearly at the abscission zone.

The fruit on the control plants (not treated with ascorbic acid) was much harder to remove from the tree, and some of the fruit was plugged.

In tests with Valencia oranges the ascorbic acid treatment loosened mature fruit during April in Florida and was found to have no effect on small green fruit of the next year's crop, nor any effect on immature fruit of the current crop.

Ascorbic acid treatment has not yet been registered for use on fruit trees by the U.S. Department of Agriculture.

New Sources of G.A. Sought

Indian and Israeli scientists working under Public Law 480 grants are searching for new ways to obtain the plant growth regulator, gibberellic acid.

Gibberellic acid (G.A.) has many potential uses in agriculture, but, at present, the only source of this substance, which occurs naturally in minute amounts, is an Asiatic fungus (*Gibberella fujikuroi*). The acid is produced in much the same way as penicillin—by growing the fungus in a nutrient solution and then extracting the material desired.

The Indian scientists, stationed at Calcutta University, have detected gibberellic acid or a similar compound in the roots of the water-hyacinth (*Eichhornia crassipes*), an aquatic weed that clogs waterways and drainage canals.

The Israeli scientists located at the Israel Institute of Technology, Haifa, are trying to synthesize gibberellic acid or related compounds.

A useful plant hormone, gibberellic acid can accelerate bud and fruit growth or overcome dwarfism in some plants. In greenhouse experiments it increased new growth of young forest trees, such as willow, oak, tulip, poplar and maple.

Applying the acid to table grapes of the Thompson seedless variety so improved fruit size and quality that over 35,000 acres of this variety in the United States are sprayed with G.A. each year.

Public Law 480 grants are paid for with foreign currency obtained by the United States from sales of farm products abroad. This money cannot be converted into dollars for use in the United States. ARS administers all foreign agricultural research done under Public Law 480.

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AGRISEARCH NOTES

Animal Fats Come Back

ARS CHEMISTS MAY have opened the way for an industrial comeback of animal fats, which have been cheap and plentiful since soap manufacturers sharply cut back their use years ago.

These saturated fats have been of little value in industry because the fatty acid molecules do not have enough "handles" in their chemical structure to engage in chemical reactions.

E. S. Rothman and other chemists at the ARS Eastern utilization research laboratory in Philadelphia have found a way to provide a convenient handle.

The ARS chemists convert the relatively inert fatty acids into highly reactive compounds by combining the acids with the enolic form of acetone. The reactive group of compounds are called fatty acid enol esters.

Preliminary findings indicate the altered fats may have important uses in such diverse products as medicines, lubricants, paper, textiles, leather, and food.

Having produced such a highly reactive form of an animal fat derivative, Rothman began to combine it with other compounds that might be made more useful by the fatty characteristics imparted to them. He showed, for example, that barbituric acid drugs could be made oil-soluble and, thus, longer-lasting, by reaction with isopropenyl stearate.

Although no large-scale experiments have yet been attempted with these enol esters, the ARS chemists have prepared polymers to make plastic formulations. They also produced an unusual four-membered ring compound similar to the lactone product long used as a paper-sizing agent. Then by a chemical arrangement of this compound, they have prepared a material with 21 carbons to its chain, known as a diketone, which is of possible use as a lubricant.

Rothman is now seeking to react animal fat derivatives with leather, cotton, and other textiles. Hopefully, a process may result from this research for the permanent waterproofing of these materials.

Alfalfa Germplasm Pools Released

Four pools of alfalfa germplasm that have valuable disease and insect resistant characteristics should aid the development of new multiple pest resistant alfalfa varieties.

Designated MSA–W4, MSB–W4, MSA–A3, and MSB–A3, the pools were developed cooperatively by ARS and the North Carolina Agricultural Experiment Station as part of a long-range program to develop such improved alfalfas (AGR. RES., June 1966, p. 10). They were recently released to plant breeders.

Germplasm pools serve as reservoirs of superior genes. They are broad-based plant populations that were improved through breeding to increase the favorable genes by repeated selection. Plant breeders use the favorable genes from these pools in selecting and breeding improved varieties.

Plants in all four germplasm pools are more persistent and vigorous than commercial varieties now grown in the Eastern United States.

MSA–W4 and MSB–W4 are unrelated populations of alfalfa that have undergone 14 cycles of selection. They are vigorous, dark-green, and resistant to potato leafhopper yellowing and rust. MSA–W4 also has good resistance to bacterial wilt.

MSA–A3 and MSB–A3 are unrelated populations which have undergone 10 cycles of recurrent selection. They are both dark-green and resistant to the spotted alfalfa aphid, potato leafhopper yellowing, and rust. MSB–A3 is very susceptible to bacterial wilt, but MSA–A3 has some resistance. They have a narrower gene base and are somewhat less resistant to leafhopper yellowing than MSA–W4, and MSB–W4.

CAUTION: In using pesticides discussed in this publication, follow directions and heed precautions on pesticide labels. Be particularly careful where there is danger to wildlife or possible contamination of water supplies.